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CENTRIFUGAL MILL

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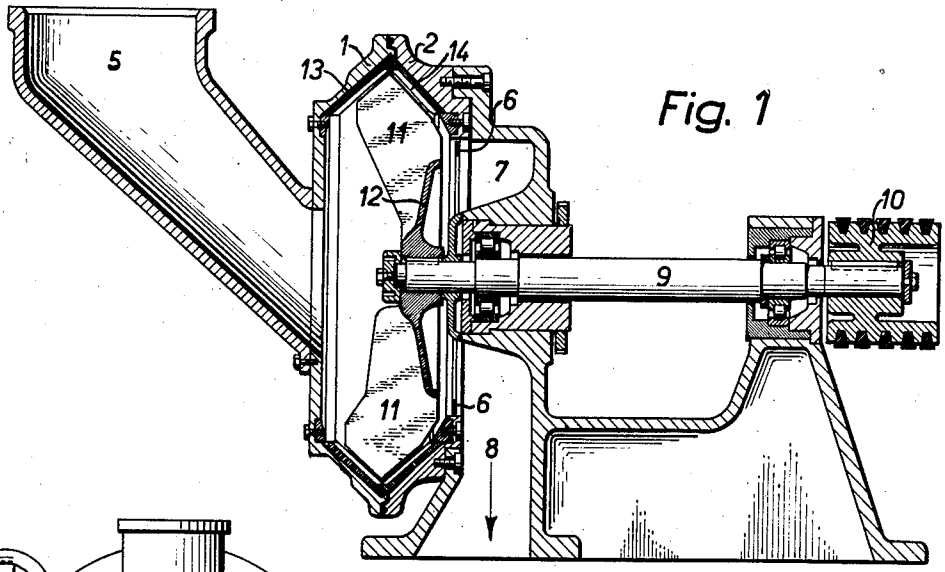


Fig. 1

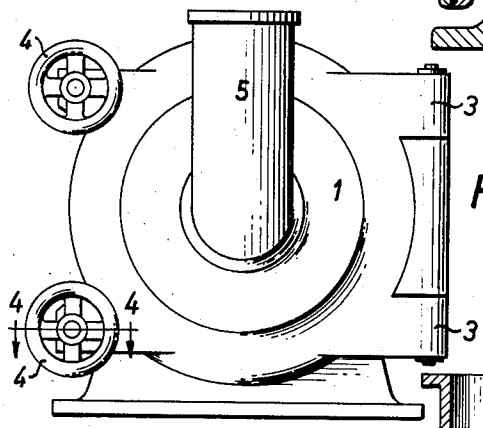


Fig. 2

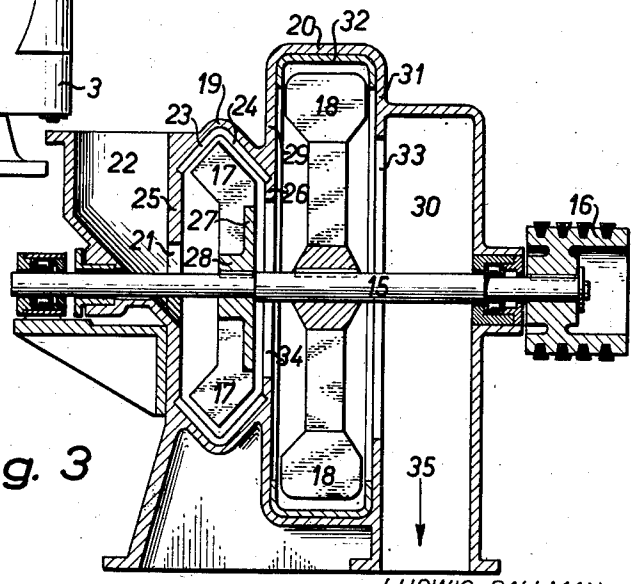
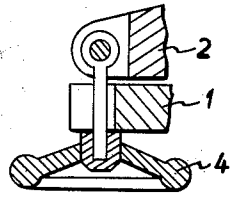


Fig. 3

Fig. 4



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CENTRIFUGAL MILL

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The present invention relates to a new type of centrifugal mill with which various substances such as e. g. minerals, chemicals, plastics, wood, leather, cellulose, paper, bones or the like can be economically broken up or broken down into fibres. The material is reduced to a definite degree of fineness and is automatically removed from the mill without the necessity of any mechanically-acting separators such as sieves, slots or the like. Mechanically acting separators tend to be blocked by the larger particles and then are no longer able to function.

One prior art centrifugal mill of this general type is a baffle plate mill in which the one half of a housing composed of two shells separated by a narrow gap rotates in a direction opposite to the direction of rotation of a beater cross in the housing. In this arrangement, the centrifugal air stream discharges those particles that are smaller in size than the width of the slot. The slot does not clog up because one edge of the slot moves in the direction of the length of the slot. Two motors are required, one to rotate the housing shell in one direction and one to rotate the beater cross in the opposite direction.

The present invention functions in the same general manner as the described prior art centrifugal mill but requires only one motor and with the one motor has a greater output than the prior art device.

The mill, according to the present invention, consists of a fixed housing containing a rotating beater cross or the like. The housing forms an impact chamber and the inner peripheral zone of this chamber, which may be termed an annular processing zone, is in the form of a circumferential trough or channel concentric to the axis of the rotating beater cross. This annular peripheral processing zone may be U-shaped or V-shaped in cross-sectional configuration and is provided with hard uneven impact surfaces. For this purpose, the impact surfaces may be ribbed. The beater cross comprises a rotor having a central disc portion and radial beater blades.

The material is continually struck by the vanes of the rotor and continually makes impact against the hard surfaces of the impact ribs so that the material is progressively reduced in size. The particles are not only broken up by impact against the ribbed impact surfaces but are also moved or carried across the impact ribs with the ribs acting in the manner of a file to shave off portions of the particles.

The impact chamber has a concentric feed opening on one side and a concentric discharge opening on its opposite side. The discharge opening is of annular configuration and its diameter is greater than the diameter of the feed opening. By virtue of this arrangement, operation of the device creates a current of air which has an axial component in the direction from the feed opening to the discharge opening. The coarse particles under process in the impact chamber are affected primarily by the vanes of the rotor and move substantially in a direction generally perpendicular to the axis of rotation of the rotor as they are repeatedly thrown against the impact surfaces. The finer particles, however, are acted upon primarily by the axial component of the air current and are thus moved to and through the discharge opening.

In the preferred practice of the invention, the annular discharge opening is a restricting annular slit. The magnitude of the axial component of the air current depends upon the resistance of air flow, this resistance including

the resistance to air flow through the annular slit. In the preferred practice of the invention, interchangeable rings are employed to permit adjustment of the width or radial dimension of the annular discharge slit. If desired, the screens may be mounted on corresponding interchangeable rotors.

In one practice of the invention, a gang of at least two of the impact mills arranged in tandem is provided to operate on the material in stages, the diameters of the mills being successively increased. The material from one mill discharges into the successive mill.

The smaller the particles become in the course of the milling operation the less they are able to penetrate an air buffer of more or less compressed air in the impact channel of the annular processing zone and the less they are able to resist the axial component of the air current. Thus, when the particles reach the desired degree of fineness they are carried out through the annular discharge slit by the air current.

The invention may be understood by referring to the following detailed description considered with the accompanying drawings.

In the drawings which are to be regarded as merely illustrative:

Figure 1 is a vertical axial section through a closed one-stage mill according to the invention;

Figure 2 is an elevation of the mill of Figure 1 from the side of the filling hopper;

Figure 3 is a vertical cross section through a two-stage mill according to the present invention; and

Figure 4 is a sectional view taken as indicated by the line 4—4 of Figure 2 and showing a hand wheel that is provided to secure a hinged portion of the machine.

Referring to the drawings, the housing of the device consists of two concavo-convex shells, designated 1 and 2, forming an impact chamber of circular configuration, which impact chamber provides a peripheral annular channel-shaped processing zone. The shell 2 is fixed and the shell 1 is mounted thereon by means of hinges 3. The shell 1 may be locked in closed position by means of a pair of hand wheels 4, each of the hand wheels being mounted on a pivoted bolt as shown.

Mounted on the side of the shell 1 is a filling hopper 5, the inner end of which forms the concentric feed opening in the impact chamber. On the opposite side of the chamber is the annular discharge opening or slit, the outer circumferential edge of which is formed by a demountable ring screen 6. The ring screen 6 is one of a set of interchangeable ring screens to permit variation in the dimension of the discharge slit. The annular discharge slit communicates with an annular collecting channel 7 from which material gravitates downward as indicated by the arrow 8.

Journaled in the fixed structure of the housing is a shaft 9 having a pulley 10 on its outer end by means of which the shaft may be power driven. Mounted on the inner end of the shaft 9 is a rotor having radial beater vanes or blades 11 and a central hub 12, the hub having the general configuration of a dished disc. As may be seen in Figure 1, the periphery of the hub 12 is spaced from the ring 6 to define therewith the previously mentioned discharge opening or annular slit through which material is discharged into the collecting channel 7. It is the width of this annular discharge slit which determines the velocity of the air current that is discharged from the impact chamber and thereby determines the size of the ground material that is discharged into the collecting channel 7.

In the preferred practice of the invention, the impact surfaces in the annular processing zone of the impact chamber are provided by replaceable liner plates, which liner plates are of conically curved configuration and may be anchored in place by screws as shown. Thus, Figure 1 shows ribbed steel plates 13 and 14 mounted

inside the shells 1 and 2, respectively, and providing peripheral inner wall surfaces of ribbed or broken configuration against which the material to be ground is thrown by the blades 11 of the rotor 12.

The manner in which the material is reduced in size depends upon the physical nature of the material. Many materials are broken up in large parts by impact against the impact surfaces of the annular processing zone. If the material is relatively soft and tough as in the case of rubber waste, wood waste and leather waste, the particles of the material are largely reduced by the shaving action of the sharp edges of the ribbed impact surfaces. The pulsating air current reduced by the rotor 12 and directed continuously against the impact surfaces insures the necessary cooling of the impact surfaces. By virtue of this cooling action, even heat-sensitive materials such as rubber, plastics and the like are not injured and do not undergo any chemical or physical changes.

The two-stage mill shown in Figure 3 has a suitably journaled shaft 15 provided with a pulley 16 by means of which it may be power driven. Mounted on the shaft 15 are two axially spaced rotors 17 and 18 for rotation at the same angular velocity inside corresponding impact chambers 19 and 20.

The impact chamber 19 has a central concentric feed opening 21 to which material is supplied by a hopper 22. The impact chamber 19 is of the same configuration as the impact chamber of the first described embodiment of the invention and includes ribbed steel impact plates 23 and 24 corresponding to the previously described impact plates 13 and 14. The feed opening 21 which is formed by the side wall 25 of the impact chamber is concentric to the shaft 15 and is of smaller diameter than an outlet opening 34 on the opposite side of the impact chamber. The outlet opening 34 is also concentric to the shaft 15 and is formed by the opposite side wall 26 of the impact chamber 19. The rotor 17 in the impact chamber 19 has a hub or central disc portion 27 integral with a boss 28 and the periphery of the disc portion 27 is spaced from the rim of the outlet opening 34 to form therewith an annular outlet slit.

The side wall 26 of the impact chamber 19 is extended radially outward as indicated at 29 to form the side wall of the adjacent impact chamber 20. The impact chamber 20 has a second opposite side wall 31. The impact chamber has an annular peripheral processing zone that is lined by an impact plate 32 of the required broken or ribbed surface configuration. As may be seen in Figure 3, the peripheral wall of the impact chamber 20 is cylindrical and of substantial width and the impact liner 32 conforms to this configuration. The ribbing of the impact liner 32 is substantially finer than the ribbing of the impact liners 23 and 24 since the second impact chamber 20 works on particles of smaller size.

The second side wall 31 of the second impact chamber 20 has a concentric discharge opening 33 directed into a collecting channel 30, and the material drops gravitationally from the collecting channel as indicated by the arrow 35. The diameter of the discharge opening 33 is greater than the diameter of the outlet opening 34 to create the desired tendency for air to flow from the annular slit at the outlet opening 34 through the impact chamber 20 and through the discharge opening 33 into the collecting channel 30. This tendency for air flow through the impact chamber 20 may be reduced by reducing the diameter of the discharge opening 30 relative to the diameter of the outlet opening 34. Reduction of this tendency by reducing the diameter of the discharge opening 33 relative to the outlet opening 26 decreases the size of the particles that are alternately discharged into the collecting channel 30. If desired, the diameter of the discharge opening 33 may be reduced merely by adding a ring to the circumferential edge of the opening.

The manner in which the material is processed in two stages by the construction shown in Figure 3 may be readily understood. The material is initially processed in the impact chamber 19 for reduction therein to particles of intermediate size. The particles of intermediate size are reduced to particles of the desired fineness in the second impact chamber 20 and are then discharged into the collecting channel 30.

What is claimed is:

1. A device of the character described, comprising: a pair of concavo-convex shells; means coaxially mounting said shells to form an impact chamber of circular configuration; the rim portions of said shells converging to form a peripheral zone within said chamber; the inner surface of said rim portions being of uneven configuration to provide numerous impact surfaces; means carried by one shell defining a central opening into said chamber for feeding material thereinto; a rotor in said chamber comprising a disc having a plurality of radially extending blades, the terminal portions of said blades extending outward into said peripheral zone and being of a configuration to conform with the configuration of said peripheral zone; means for rotatably driving said rotor; the other of said shells having a circular discharge opening concentric with said disc and of a diameter slightly larger than said disc whereby said disc substantially spans said discharge opening; the peripheral edge of said disc coacting with the defining edge of said discharge opening to define an annular slit forming an exit passage for material into said discharge opening; material fed into said chamber being caused to strike back and forth repeatedly between said rotor blades and the wall means defining said peripheral zone to break the material into fine particles in said region before passage through said slit into said discharge opening.

2. A device of the character described, comprising: opposed wall means defining an impact chamber of circular configuration; the peripheral portions of said wall means converging to form an annular processing zone within said chamber; means defining a central opening at one side of said chamber for feeding material thereinto, the converging wall means having surfaces of rib-like configuration to provide a plurality of impact surfaces; a rotor coaxially mounted in said chamber, said rotor comprising a disc having a plurality of radially extending blades, the terminal portions of said blades extending outward into said peripheral zone and being of a configuration to conform with the configuration of said processing zone; means for rotating said rotor; means defining a discharge opening from said chamber opposite said inlet opening and concentric with said disc; said disc substantially spanning said discharge opening; a replaceable ring member mounted within said discharge opening for varying the size thereof, said material being caused to strike back and forth repeatedly between said rotor blades and the wall means defining said peripheral zone to break the material into fine particles in said region before passage into said discharge opening, the relative diameter of said disc and the opening of said ring member determining the size of particles passing into said discharge opening.

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